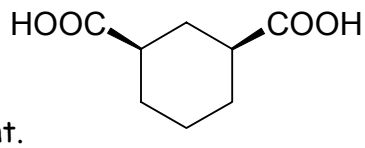
CHEM221 Section 02 Dr. C. Rogers **NAME:**

INTRODUCTORY ORGANIC CHEMISTRY I --- **PROBLEM SET #3**

INSTRUCTIONS: HAND IN STAPLED, COMPLETED ASSIGNMENT (no extra pages please) **AT THE BEGINNING OF CLASS on Thursday March 24th**. LATE SUBMISSIONS WILL **NOT** BE ACCEPTED (EARLY IS OK). ANSWER ALL QUESTIONS, BUT ONLY 3 WILL BE MARKED. ALL MATERIAL WILL BE COVERED BEFORE THE DUE DATE.

 # 1. The structure of *cis*-1,3-cyclohexanedicarboxylic acid is shown.
(No, you are not responsible for naming carboxylic acids).



As for all cyclohexanes, most molecules of this compound would be found in a chair conformation if we could take a snapshot of a sample at any given moment.

a) Draw the chair-chair interconversion equilibrium for this compound. Identify the conformation most molecules of this dicarboxylic acid would adopt in an aqueous solution. Explain why you expect this conformation would be favoured (include sketches of relevant interactions).

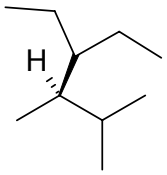
b) If the pH of the aqueous solution from part (a) is adjusted to be strongly alkaline (*e.g.,* pH 12), the equilibrium between the two types of chair conformations will shift. Which conformation will be preferred at this pH? Why? (Include drawings in your explanation, as you did in part (a)).

 # 2. Draw skeletal (line) structures of the following molecules (note stereochemistry!):

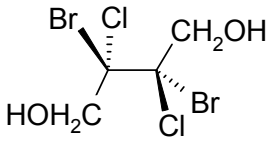
i) (2*R*,3*R*)-2-bromo-3-chloropentane **ii)** (*R*)-1,1,2-trimethylcyclohexane

 # 3. In the following molecules, label all asymmetric centres with an asterisk (*) and all mirror planes with a sigma (σ). Identify the molecules as **chiral** or **achiral**. If chiral, draw the molecule's enantiomer. If achiral, identify the feature that makes the molecule achiral; use the term "meso" where appropriate.

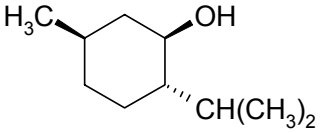
a)



b)

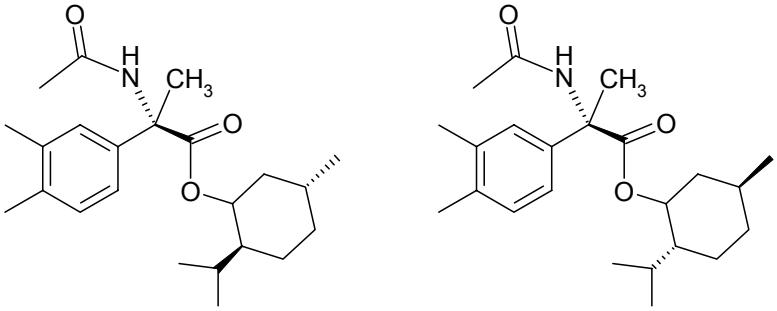


c)

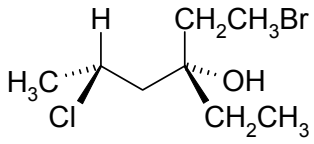


common name: menthol

 # 4. What is the relationship between these two molecules? Explain.



 # 5. Draw all the stereoisomers for the structure shown at the right. Name all compounds & assign R/S configurations to all asymmetric centres. Use the labels *optically active*, *optically inactive*, *enantiomer*, *diastereomer* as appropriate to describe the molecules and their relationships.



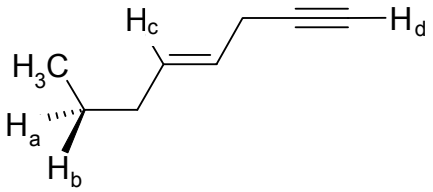
 # 6. The specific rotation of (*S*)-2-iodobutane is +15.90°.

a) Draw the structure of (*S*)-2-iodobutane.

b) Predict the specific rotation of (*R*)-2-iodobutane.

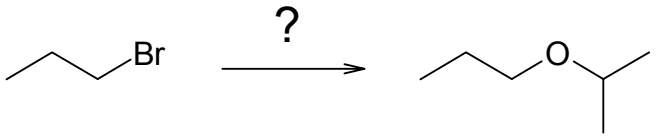
c) A certain mixture of (*R*)- and (*S*)-2-iodobutane was found have a specific rotation of -7.95°. What percent of the iodobutane molecules in the sample were dextrorotatory? Show your work.

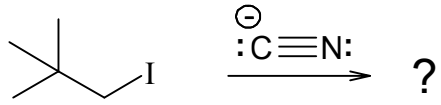
 # 7. When thinking about the acidity of a molecule, we normally consider the stability of the molecule's conjugate base. Use this concept and your knowledge of orbital sizes to <u>explain</u> the relative acidities of protons H_a, H_b, H_c, H_d in the molecule shown.

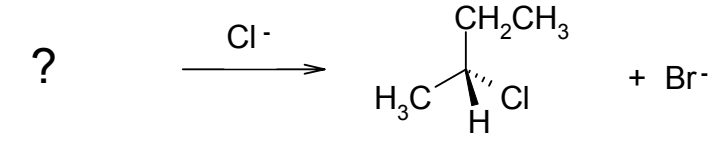


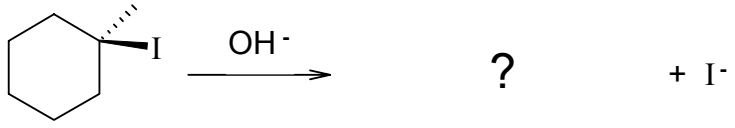
HINT: Look up pK_as of related compounds to find the acidity trend; and then EXPLAIN why it is like this!

#8. [Ch.10] Draw the missing reactant(s) / product(s) for the following transformations in the boxes:

a) 

b) 

c) 

d) 

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